TYPES, AMOUNTS AND EFFECTS OF INDUSTRIAL SOLID WASTES

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Keywords: Solid waste, hazardous waste, industrial solid waste, waste generation, waste management, environmental protection, waste category, environmental effect, water, air, soil, route, environment pollution

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Summary

The industrial solid wastes have done harm to the environment and human health. The first step towards prevention and control of pollution of industrial solid wastes that the types, is a full understanding of amounts and effects. The intrinsic characteristics of industrial solid wastes include occupying land when stockpiling, dumping, disposing or storing, having large categories and quantity. In this chapter, solid wastes from mining industry, metallurgical industry, power industry, chemical industry, oil chemical industry, and light industry are introduced and the waste generation coefficient in these industries also summarized. The environment effects, including natural environment, atmospheric environment, water environment, and soil environment, of industrial solid wastes are introduced briefly.
1. Introduction

Industrial solid waste refers to solid waste generated in production activities such as industry, traffic, and resource development. They include solid wastes, semi-solid wastes, and liquid and gaseous wastes in vessels that are not permitted to discharge into the environment. Industrial solid wastes are classified into organic wastes and inorganic wastes based on their components; into solid wastes, semi-solid wastes and liquid (gaseous) wastes based on their species; into hazardous wastes and common wastes based on pollution characteristics. Because many industrial solid wastes hold hazardous characteristics, they usually receive special attention.

Industrial solid waste pollution has become an increasingly serious problem in the world. The developing countries have to specially confront it. Every year, large quantities of industrial solid wastes are generated from the growing industries. However, there are no adequate treatment and disposal facilities and qualified personnel in these developing countries. All these have seriously hindered the development of industries in these countries and done harm to the human being health and the environment.

During 1980s, much attention has been paid to the pollution control of industrial solid wastes. Significant progress has been made in establishing corresponding management and legislation systems, in developing treatment and disposal technologies, and in turning the research results into industrial practice. As a result, the serious situation of hazardous waste pollution has been alleviated in the developed countries although this situation has not completely changed. However, many problems in the management of industrial solid wastes need to be resolved in the developing countries.

2. Types of Industrial Solid Wastes

In general, industrial solid wastes are classified into the following major types:

(1) Solid wastes from the mining industry

This kind of waste includes waste stones generated during mining and tailings. Waste stones mean wall rocks peeled off from major ore during the mining of metal and non-metal mines. Tailings mean the residue slag after distilling refining mines during mill run.

(2) Industrial solid wastes from the metallurgical industry

This kind of waste includes varies of slag from the metallurgical procedure and processing of metals and non-metals. Some industrial solid wastes from the metallurgical industry are listed in Table 1.

<table>
<thead>
<tr>
<th>Slag</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast furnace slag</td>
<td>Generated in blast furnace iron smelting</td>
</tr>
<tr>
<td>Steel slag</td>
<td>Generated in steel smelting by level furnace, converter, and electric stove</td>
</tr>
</tbody>
</table>
(3) Solid wastes from the power industry

This kind of waste includes coal fly ash, coal slag, and flue ash from power plants in which coals are used as fuel. It also includes gangue generated from coal excavating and coal-washing.

(4) Solid wastes from the chemical industry

This kind of wastes includes inferior products (semi-finished products), outgrowth, disabled catalysts, waste additives, raw materials that have not reacted, and impurity in raw materials discharged from chemical reaction during production processes, such as chemical combination, decomposition and synthesis. They also include wastes discharged from refining, separating, and washing procedures and from devices. Furthermore, they include the pyritic slag, acidic slag, alkali slag, salt mud, mud from kettle, residues of refining or distillation, pharmaceutical wastes, waste medicines from the producing and processing sectors in the chemical industry, and waste pesticides from medicine and insecticide production. In addition, they include dust from air pollution control facilities, sludge from wastewater treatment facilities, solid wastes from equipment examination and repairing, equipment scraps, vessels, and industrial refuses.

(5) Solid wastes from the oil chemical industry

This kind of wastes includes oil mud, tar shale slag, waste catalysts, and waste organic solvent in oil processing.

(6) Solid wastes from light industry

This kind of wastes includes sludge, animal residues, waste acid, waste alkali, and other wastes from the processing procedure in light industries, such as food industry, paper making and printing industry, spinning and dye-printing industry, and leather industry.

(7) Other industrial solid wastes

These kinds of waste mainly include metal dross from mechanical processing, plating sludge, construction wastes, and slag from processing in other industries.

In the USA, solid wastes means any garbage, refuse, sludge from a wastewater treatment plant, a water supply treatment plant, or an air pollution control facility; and other discarded materials including solid, liquid, semi-solid, or contained gaseous materials arising from industrial, commercial, mining, and agricultural operations, and from community activities; but does not include solid or dissolved materials in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges.
which are point sources subject to permits under the Federal Water Pollution Control Act, as amended, or source, special nuclear, or by-product materials as defined by the Atomic Energy Act, as amended. Industrial and special wastes are primarily non-hazardous wastes generated by certain industries and households. Industrial solid wastes come from a broad spectrum of USA industries and are neither municipal nor hazardous wastes under federal and most state laws.

Some industrial solid wastes may be listed in the catalog of hazardous wastes or identified as holding hazardous properties based on the hazardous waste identification standards and identification method. In the USA, hazardous waste is defined by RCRA as a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed. This is a definition used widely. UNEP defined, in the working group meeting of the environmental management of hazardous wastes in December of 1985 that hazardous wastes indicate wastes in solid, sludge, liquid and gases in vessels, which held chemical reactivity, toxicity, explosibility, erosion, or other characteristics that can result in adverse effects to the human health and environment. These wastes are legally called hazardous wastes even if they are mixed with other wastes, have been generated, are in disposal, or are in transportation. UNEP lists 45 categories of wastes that should be controlled, and 2 categories that need to pay special consideration in Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their disposal (Table 2). At the same time, a list of hazardous characteristics is shown (Table 3). In China, hazardous wastes are divided into 47 categories according to the National Catalog of Hazardous Wastes. It includes the 45 categories in the Basle Convention, which are named as HW1 to HW45, and two more items, which are named as HW46 for nickel compound wastes and HW 46 for barium compound wastes.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Waste source and hazardous components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y1</td>
<td>Clinical wastes from medical care in hospitals, medical centers and clinics</td>
</tr>
<tr>
<td>Y2</td>
<td>Wastes from the production and preparation of pharmaceutical products</td>
</tr>
<tr>
<td>Y3</td>
<td>Waste pharmaceuticals, drugs and medicines</td>
</tr>
<tr>
<td>Y4</td>
<td>Wastes from the production, formulation and use of biocides and phytopharmaceuticals</td>
</tr>
<tr>
<td>Y5</td>
<td>Wastes from the manufacture, formulation and use of wood preserving chemicals</td>
</tr>
<tr>
<td>Y6</td>
<td>Wastes from the production, formulation and use of organic solvents</td>
</tr>
<tr>
<td>Y7</td>
<td>Wastes from heat treatment and tempering operations containing cyanides</td>
</tr>
<tr>
<td>Y8</td>
<td>Waste mineral oils unfit for their originally intended use</td>
</tr>
<tr>
<td>Y9</td>
<td>Waste oils/water, hydrocarbons/water mixtures, emulsions</td>
</tr>
<tr>
<td>Y10</td>
<td>Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)</td>
</tr>
<tr>
<td>Y11</td>
<td>Waste tarry residues arising from refining, distillation and any pyrolytic treatment</td>
</tr>
<tr>
<td>Y12</td>
<td>Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish</td>
</tr>
<tr>
<td>Y13</td>
<td>Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives</td>
</tr>
<tr>
<td>Y14</td>
<td>Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or...</td>
</tr>
</tbody>
</table>
the environment are not known

Y15 Wastes of an explosive nature not subject to other legislation

Y16 Wastes from production, formulation and use of photographic chemicals and processing materials

Y17 Wastes resulting from surface treatment of metals and plastics

Y18 Residues arising from industrial waste disposal operations

Y19 Metal carbonyls

Y20 Beryllium; beryllium compounds

Y21 Hexavalent chromium compounds

Y22 Copper compounds

Y23 Zinc compounds

Y24 Arsenic; arsenic compounds

Y25 Selenium; selenium compounds

Y26 Cadmium; cadmium compounds

Y27 Antimony; antimony compounds

Y28 Tellurium; tellurium compounds

Y29 Mercury; mercury compounds

Y30 Thallium; thallium compounds

Y31 Lead; lead compounds

Y32 Inorganic fluorine compounds excluding calcium fluoride

Y33 Inorganic cyanides

Y34 Acidic solutions or acids in solid form

Y35 Basic solutions or bases in solid form

Y36 Asbestos (dust and fibers)

Y37 Organic phosphorus compounds

Y38 Organic cyanides

Y39 Phenols; phenol compounds including chlorophenols

Y40 Ethers

Y41 Halogenated organic solvents

Y42 Organic solvents excluding halogenated solvents

Y43 Any congenor of polychlorinated dibenzo-furan

Y44 Any congenor of polychlorinated dibenzo-p-dioxin

Y45 Organohalogen compounds other than substances referred to in this Annex (e.g. Y39, Y41, Y42, Y43, Y44)

* : Y1-18: Waste Streams
** : Y19-45: Wastes having as constituents
*** : Categories of wastes requiring special consideration includes: Y46 Wastes collected from households and Y47 Residues arising from the incineration of household wastes

Table 2: Categories of wastes to be controlled in Basel Convention

<table>
<thead>
<tr>
<th>UN Class</th>
<th>Code</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H1</td>
<td>Explosive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such speed as to cause damage to the surroundings.</td>
</tr>
<tr>
<td>3</td>
<td>H3</td>
<td>Flammable liquids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The word &quot;flammable&quot; has the same meaning as &quot;inflammable.&quot; Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapor at temperatures of not more than 60.5°C, closed-cup test, or not more than</td>
</tr>
</tbody>
</table>
65.6°C, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>H4.1 Flammable solids</td>
</tr>
<tr>
<td>4.2</td>
<td>H4.2 Substances or wastes liable to spontaneous combustion</td>
</tr>
<tr>
<td>4.3</td>
<td>H4.3 Substances or wastes which, in contact with water emit flammable gases</td>
</tr>
<tr>
<td>5.1</td>
<td>H5.1 Oxidizing</td>
</tr>
<tr>
<td>5.2</td>
<td>H5.2 Organic Peroxides</td>
</tr>
<tr>
<td>6.1</td>
<td>H6.1 Poisonous (Acute)</td>
</tr>
<tr>
<td>6.2</td>
<td>H6.2 Infectious substances</td>
</tr>
<tr>
<td>8</td>
<td>H8 Corrosives</td>
</tr>
<tr>
<td>9</td>
<td>H10 Liberation of toxic gases in contact with air or water</td>
</tr>
<tr>
<td>9</td>
<td>H11 Toxic (Delayed or chronic)</td>
</tr>
<tr>
<td>9</td>
<td>H12 Ecotoxic</td>
</tr>
<tr>
<td>9</td>
<td>H13 Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.</td>
</tr>
</tbody>
</table>

Table 3: List of Hazardous Characteristics (UN Class (2) Code Characteristics)
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Biographical Sketch

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Operation Capacity of Hazardous Wastes of China; SVE Technique for Volatile Organic Matter;
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